

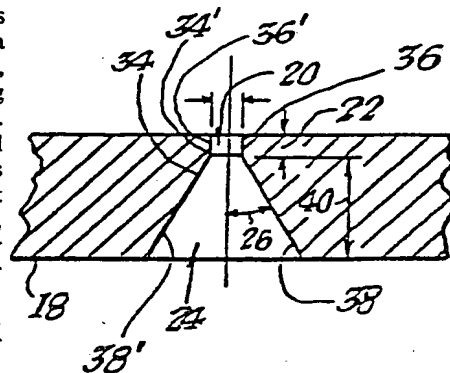


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification<sup>3</sup> :</b>  <b>B01D 39/10</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 82/ 02345</b>  <b>(43) International Publication Date:</b> 22 July 1982 (22.07.82)
<b>(21) International Application Number:</b> PCT/US82/00007 <b>(22) International Filing Date:</b> 5 January 1982 (05.01.82)  <b>(31) Priority Application Number:</b> 222,554 <b>(32) Priority Date:</b> 5 January 1981 (05.01.81) <b>(33) Priority Country:</b> US  <b>(71) Applicant:</b> MALIN & HALEY [US/US]; Suite 2110, One Financial Plaza, Fort Lauderdale, FL 33394 (US).  <b>(72) Inventor:</b> HAGIHARA, Tadashi ; 4-1, 5-chome, Mina- mi Nagasaki, Toshima-ku, Tokyo (JP).		<b>(74) Agent:</b> MALIN, Eugene F.; Suite 2110, One Financial Plaza, Fort Lauderdale, FL 33394 (US).  <b>(81) Designated States:</b> DE (European patent), DK, FR (European patent), GB (European patent), JP, SE (European patent).  <b>Published</b> <i>With international search report.</i>

**(54) Title:** V-SHAPED FILTER**(57) Abstract**

A filter element including a plate (10) between 1.0 and 10 millimeters thickness having a plurality of generally long filtering elements (12, 12', 12'') of a preferred thickness in the range of 1.5 and 5.0 millimeters. The elements (12, 12', 12'') may be arranged in long generally parallel rows (32, 32', 32'') including a portion with generally parallel sides and diverging generally V-shaped sides. Each filter slit (12) has a transverse cross-section that includes an inlet channel (20) and outlet channel portion (24). Each inlet channel portion (20) intersects its respective outlet channel portion (24) internal of the filter elements. The inlet channel portion (20) includes generally parallel planar opposed side walls (36, 36'). The preferred inlet channel portion (20) has flat, smooth parallel planar opposed side walls. The outlet channel portion (24) includes diverging planar opposed side walls (38, 38'). The preferred outlet channel portion (24) has flat, smooth diverging opposed side walls. The entrance of the outlet channel intersects at the exit (34, 34') of said inlet channel and diverges outward to the exit of the outlet channel.



BEST AVAILABLE COPY

***FOR THE PURPOSES OF INFORMATION ONLY***

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	KP	Democratic People's Republic of Korea
AU	Australia	LI	Liechtenstein
BE	Belgium	LK	Sri Lanka
BR	Brazil	LU	Luxembourg
CF	Central African Republic	MC	Monaco
CG	Congo	MG	Madagascar
CH	Switzerland	MW	Malawi
CM	Cameroon	NL	Netherlands
DE	Germany, Federal Republic of	NO	Norway
DK	Denmark	RO	Romania
FI	Finland	SE	Sweden
FR	France	SN	Senegal
GA	Gabon	SU	Soviet Union
GB	United Kingdom	TD	Chad
HU	Hungary	TG	Togo
JP	Japan	US	United States of America

## V-SHAPED FILTER

FILTER TECHNICAL FIELD

5 A self cleaning slit filter plate having slits with an inlet channel with generally parallel flat side walls starting at the upper flat surface of the plate and having the inlet channel connected to an outlet channel having diverging planar opposed side walls.



BACKGROUND ART

Plate slit filters having intermediate transverse cross-sections with an inlet channel and outlet channel have been constructed in the past. Their cross-sections show a parallel wall inlet channel of relatively great width and/or depth as well as diverging wall outlet channel leaving pocket for the accumulation of foreign material outward of the intersection of the inlet channel and outlet channel. The present invention is directed to very small plate slit filters with an outlet channel cross-section which works in complimentary relationship with fluid flow patterns to prevent build up of trash and debris in the channel. The present invention makes the inlet channel shallower and the outlet channel correspondingly deeper and of a particular configuration.

20



Disclosure Of The Invention

A new and improved filter element including a plate between 1.0 and 10 millimeters thickness normally having a plurality of generally long filtering elements of a preferred thickness in the range of 1.5 and 5.0 millimeters. The elements may be arranged in long generally parallel rows to insure symmetry of the cross-sectional shape of the filter channel including a portion with generally parallel sides and diverging generally V-shaped sides. The arrangement of filter elements one to another can be of any form lending to ease of manufacturing and servicing. The plate may take shapes such as a flat plate, circular plate, convex or concave plates or other shapes.

Each filter slit has a transverse cross-section that includes an inlet channel portion and outlet channel portion. Each inlet channel portion intersects its respective outlet channel portion internal of the filter elements. The inlet channel portion includes generally parallel planar opposed side walls. The preferred inlet channel portion has flat, smooth parallel planar opposed side walls. The outlet channel portion includes diverging planar opposed side walls. The preferred outlet channel portion has flat, smooth diverging opposed side walls. The entrance of the outlet channel intersects at the exit of said inlet channel and diverges outward to the exit of the outlet channel. Thus, the depth of



the inlet channel plus the depth of the outlet channel equal the total depth of the filter element.

The transverse cross-section of the outlet channel is a terminated "V" shape with the narrower portion intersecting the inlet channel. The intersection may be a sharp point in cross-section or a curved line in cross-section. The inlet channel connected to the outlet channel utilizes natural flow characteristics of the fluid to maintain a clean filter element.

It is an object of this invention to provide filter element with a self cleaning inlet and outlet channel.

It is another object of this invention to provide a relatively thin plate filter element with a plurality of through filter slits having a shallow inlet channel of flat, smooth parallel planar opposed side walls and an outlet channel of flat, smooth diverging opposed side walls.

In accordance with these and other objects which will be apparent hereinafter, the instant invention will now be described with particular reference to the accompanying drawings.

#### Brief Description of the Drawings

Figure 1 is a partial planar view of the filter element from the upstream side.

Figure 2 is cross-section side view elevation of the filter element taken along line 2-2 in Figure 1 and looking in the direction of the arrows.



Figure 3A is a cross-sectional view of the filter element taken along lines 3-3 in Figure 1 and looking in the directions of the arrows.

Figure 3B is another embodiment of the filter element shown in cross-section to illustrate the rounded intersection of the inlet channel and outlet channel.

Figure 4 is an enlarged view of one end of the filter slit.

Figure 5 is another enlarged view of another end of the filter slit.

Figure 6 is a cross-section of an additional filter element.

#### Preferred Embodiment of the Invention

Referring now to the Figures 1, 2 and 3 the filter plate 10 with an upstream surface 16 is constructed from stainless steel plate or other metals or other material in which there are a plurality of through slits 12. The plates preferably may be 1.5 to 5 millimeters thick, or thicker. These filter slits 12, 12' and 12" are arranged in a plurality of generally parallel rows 32, 32', 32". The filter elements may be arranged in other configurations. The filter element may be straight as illustrated or in other configurations such as arcuate.

Each through slit 12, 12' and 12" comprises an inlet channel 20 intersecting the upstream surface or side 16 and an outlet channel 24 which



exits the downstream side 18. The inlet channel 20 and outlet channel 24 intersect at a line 12 as shown in Figure 2 and a point 34 and 34' as shown in Figure 3A internal of the filter element plate 10. The inlet channel 20 is established in the upstream side 16 and the outlet channel 24 is established in the downstream side 18 by removal of material from the plate or by molding the plate.

10 In all embodiments the inlet channel 20 has smooth, flat parallel planar opposed side walls 36 and 36'. The entrance is at surface 16. The width of the channel is narrow. The depth of the channel is shallow.

15 In all the embodiments the outlet channel shown in Figure 3A have smooth, flat diverging planar opposed side walls 38 and 38'. The outlet channel 24 diverges from its entrance at the intersection points 34 and 34' within the inlet  
20 channel 20. The intersection between the inlet channel and outlet channel is important in that an abrupt fluid pressure drop is created at the intersection of the inlet channel and outlet channel preventing collection of debris within  
25 the filter element. No pockets, or undercuts are presented to the passing fluid. The outlet channel is generally V-shaped, but may be of other shape which provide the self cleaning of the outlet walls by the passing liquid.

30





The depth of the inlet channel may be between 0.1 to 0.3 millimeters but may be of greater depth. The preferable depth is 0.2 millimeters.

Another possible version of outlet channel is  
5 to construct the outlet channel's transverse cross-section having a smooth arcuately convex shaped opposed diverging side walls having the inlet channels narrowest point at its entrance  
10 50 diverging to its widest point 52 at the outlet channel exit. In either the V-shaped or arcuate shaped transverse cross-section the degree of divergence or angle 26 is between 40 to 60 degrees with a preferred included angle of 45-50 degrees. The angle being measured from the entrance point  
15 34, 34' or A to the exit point B.

The filter element includes a plate that may be made from a stainless steel plate or other material including but not limited to plastic with suitable characteristics and wear properties.  
20 The width C of the inlet slit at the entrance to the inlet channel is between 0.5 and 0.06 millimeters. The cross-section area of the inlet channel may be a square area or a rectangular area.

The inlet surface or face 16 of the filter  
25 element plate on which debris accumulates during filtration may be cleaned by a wiper or scraper blade 70 made of a suitable material moved relative to and across the face of the filter element plate, either parallel to the longitudinal axis of the  
30 filter slits as shown in Figure 2 or in a transverse direction.



The filter slit configuration is such that pockets, troughs or undercuts of low pressure are eliminated. Therefore there are no potential points of build up for trash and debris to attach itself. Figures 3A and 6 illustrate two configurations.

The plate thickness may range from 10 to 1.5 millimeters. The preferred thickness is 1.5 to 5 millimeters. The inlet channel may have a depth of preferably 0.2 millimeters. The depth may vary from 0.1 to 0.3 millimeters. The width C of the inlet channel entrance is between 0.5 millimeters to 0.06 millimeters. The mid width is 0.2 millimeters.

In the embodiment shown in Figure 6 the radius R may vary but is preferably large to approximate the shape in Figure 3A.

The filter element may be used for liquids with viscosities above and below the preferred range. The pressure and flow rate ranges to which the V-shaped filter element can be suitably applied depending upon the thickness of the plate, but, in usual or preferred applications are applied at from 10 to 30 bars, or 10 to 30 barometric pressure and for 1 to 200,000 cubic meters per hour, but may be used at pressures and flows below the preferred range.

Referring now to Figure 3B, the junction between the inlet channel and the outlet channel

34" and 34'" may have a radius or be arcuate to eliminate the sharp junction shown in Figure 3A.

Figure 4 illustrates a molded channel end 40 having straight smooth flat inlet channel portion or wall 42 and smooth flat outlet channel portion 44 that may have the same angles as sides 38 and 38". The outlet surface may also be shaped as walls 38" and 38'" in Figure 6.

Figure 5 shows another embodiment of a machined filter channel end 40' having an inlet channel with a smooth arcuate or radius surface 41. The outlet channel portion 43 may also have a smooth arcuate or radius surface.

The instant invention has been shown and described herein in what is considered to be the most practical and preferred embodiment. It is recognized, however, that departures may be made therefrom within the scope of the invention and that obvious modifications will occur to a person skilled in the art.



What I Claim Is:

1. A filter element comprising:
  - a plate having an upstream side and a downstream side;
  - 5 a long through slit having an inlet channel and an outlet channel, said inlet channel fluidly connected at a junction with said outlet channel;
  - 10 said inlet channel of shallow depth having a pair of smooth generally parallel planar opposed side walls, said inlet channel opening on said upstream side and exiting into said outlet channel internally in said plate at said junction;
  - 15 said outlet channel having a pair smooth opposed, diverging side walls exiting on said downstream side, said diverging side walls having a flat to convex shape.
- 20 2. A filter element as set forth in Claim 1 wherein:
  - said inlet channel has a depth of generally between 0.1 millimeter and 0.3 millimeters and has a narrow width.
- 25 3. A filter element as set forth in Claim 1 wherein:
  - said outlet channel has a diverging angle of between forty to sixty degrees from said junction to said downstream side.



11

4. A filter element as set forth in Claim 1  
wherein:  
said inlet channel has a width of between  
0.5 millimeters and 0.06 millimeters.
- 5 5. A filter as set forth in Claims 1, 2, 3 and  
4 wherein:  
said diverging sidewalls of said outlet  
channel are flat.
- 10 6. A filter as set forth in Claim 5 wherein:  
said junction between said inlet channel  
and said outlet channel is a sharp edge.
- 15 7. A filter as set forth in Claim 5 wherein:  
said junction between said inlet channel  
and said outlet channel is a smooth  
arcuate surface.
8. A filter as shown and described herein.

20

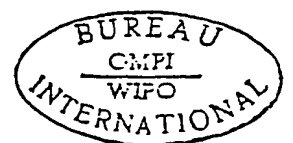
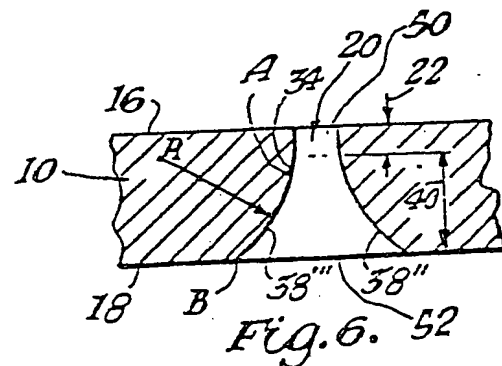
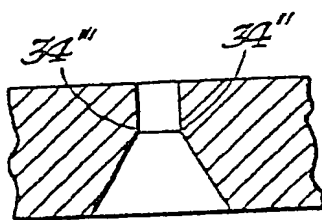
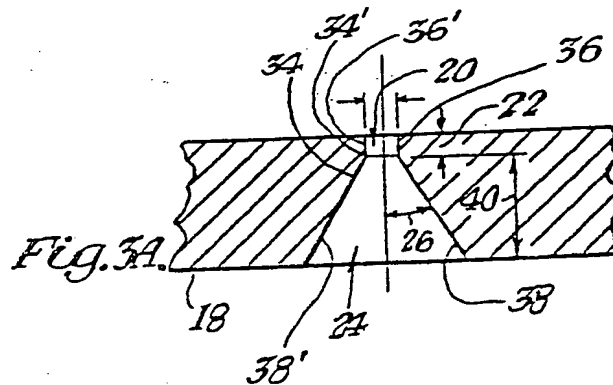
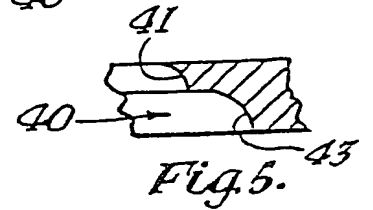
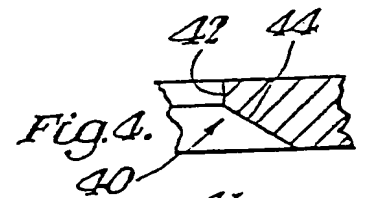
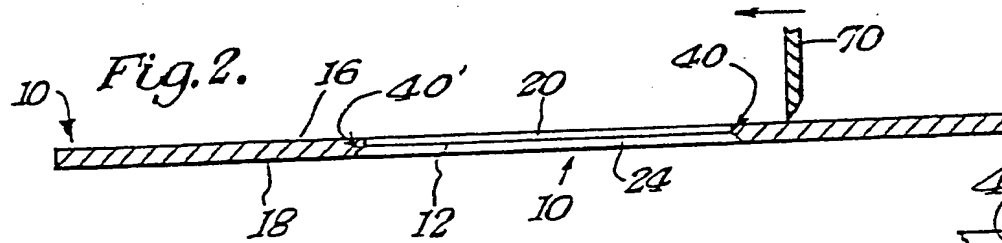
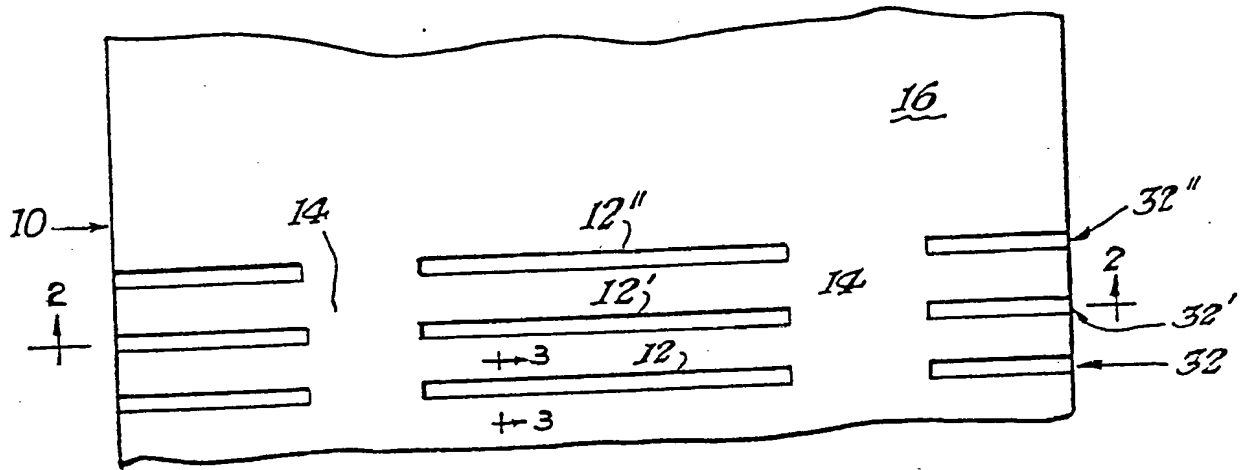


Fig. 1.

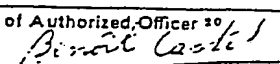


BEST AVAILABLE COPY

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/US82/00007

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC INT. CL. <sup>3</sup> B01D 39/10 U.S. CL. 210/498; 209/397, 398, 399		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched *		
Classification System	Classification Symbols	
U.S.	210/498; 209/397	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched *		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT</b> 14		
Category *	Citation of Document, 16 with Indication, where appropriate, of the relevant passages 17	Relevant to Claim No. 18
X	US,A, 1,940,952, PUBLISHED 26 DECEMBER 1933, HUTCHENS.	1-4
X	US,A, 3,277,814, PUBLISHED 11 OCTOBER 1966, MALM ET AL.	1-4
X	US,A, 1,916,393, PUBLISHED 04 JULY 1933, SMITH.	1-4
A	US,A, 105,755, PUBLISHED 26 JULY 1870, WINCHESTER.	1-4
A	US,A, 206,632, PUBLISHED 30 JULY 1878, SNELL.	1-4
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>* Special categories of cited documents: 15</p> <p>"A" document defining the general state of the art</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document cited for special reason other than those referred to in the other categories</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> </div> <div style="width: 45%;"> <p>"P" document published prior to the international filing date but on or after the priority date claimed</p> <p>"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance</p> </div> </div>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search *	Date of Mailing of this International Search Report *	
25 MARCH 1982	14 APR 1982	
International Searching Authority *	Signature of Authorized Officer 20	
ISA/US	 BENOIT CASTEL	

Form PCT/ISA/210 (second sheet) (October 1977)

## FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

V. ☒ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE <sup>10</sup>

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☒ Claim numbers 5-8, because they relate to subject matter <sup>11</sup> not required to be searched by this Authority, namely:

Claims 5-7 do not conform to the requirements of Rule 6.4(a).

Claim 8 is specifically prohibited by Rule 6.2(a).

2. ☐ Claim numbers \_\_\_\_\_, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out <sup>11</sup>, specifically:

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING <sup>11</sup>

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

## Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.